GE Energy

Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz

Noise emission characteristics

Normal operation according to IEC

GE imagination at work

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1 Introduction

The noise emission characteristics of the GE Energy wind turbine series GE 1.5sl and 1.5sle with a rotor diameter of 77-m, 50 and 60 Hz versions, including Cold Weather Extreme versions, comprise sound power level data, tonality values, third octave band and octave band spectra.

This document describes the noise characteristics of the turbine for normal operation. Noise-reduced operation (NRO) is described in document [1.5sl_sle_SCD_allcomp_NRO].

The data here provided is calculated from simulations and has been confirmed by several measurements, including those performed by independent institutes.

The sound power level (L_{WA}) is calculated at hub height over the entire wind speed range from cut-in wind speed to cut out wind speed. For the maximum sound power level a reference value and uncertainty band are specified. Tabled L_{WA}-values are given as function of hub height wind speed (reference values) and as a function of wind speed at 10-m height, assuming standard hub height and logarithmic wind profile for surface roughness ($z_{0, ref}$) = 0.03 m, see section 2.2. Characteristics as a function of wind speed at 10-meter height for different combinations of hub height and wind shear profile can be provided at request.

If a wind turbine noise performance test is carried out, it needs to be done in accordance with the regulations of the international standard IEC 61400-11: 2002 (abstract available upon request).

2 Sound Power Level Data

2.1 L_{WA} as a function of hub height wind speed

The following table provides the calculated reference mean sound power level values as a function of wind speed.

Wind speed at hub height [m/s]	GE 1.5 sl/sle all hub heights L_{WA} [dB]
3	< 96
4	< 96
5	< 96
6	96.6
7	99.8
8	102.7
9 – cut out	≤ 104.0

Table 2-1: Mean sound power level as function of hub height wind speed

2.2 L_{WA} as a function of wind speed at 10-m height

Following are tabled values for the L_{WA} as a function of the wind speed at 10-meter height for different hub heights. The wind speed is converted using a standard logarithmic wind profile, in this case using a surface roughness of (z_{0ref}) = 0.03 m, which is representative for average terrain conditions.

$$V_{10m\ height} = V_{hub} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)} \quad [1]$$

Characteristics for other combinations of surface roughness and hub height are available upon request.

Wind speed at 10-m height [m/s]	GE 1.5 sl/sle 61.4-m HH L_{WA} [dB]	GE 1.5 sl/sle 70-m HH L_{WA} [dB]	GE 1.5 sl/sle 80-m HH L_{WA} [dB]	GE 1.5 sl/sle 85-m HH L_{WA} [dB]	GE 1.5 sl/sle 100-m HH L_{WA} [dB]
3	< 96	< 96	< 96	< 96	< 96
4	< 96	< 96	< 96	< 96	96.1
5	98.4	98.7	99.1	99.3	99.7
6	102.4	102.8	103.0	103.1	103.3
7– cut out	≤ 104	≤ 104	≤ 104	≤ 104	≤ 104

Table 2-2: Sound power level characteristics for different hub heights as function of wind speed at 10 m height

3 Uncertainty Levels

Mean uncertainty levels for the sound power, or K-factors, are derived from independent measurements. Their value depends on the applied probability level and standard deviation for reproducibility (σ_R), as described in the IEC 61400-14 TS ed. 1[2]. Because the K-factor depends on the quality of the measurements, the number of the measurements, and on local regulations, a fixed value is here used instead to define the uncertainty band with respect to the reference sound power level.

For all 1.5sl and 1.5sle turbines an uncertainty band of **(K) = ± 2.0 dB** is defined.

4 Tonality

At the reference measuring point R_o, a ground distance from the turbine base equal to hub height plus half the rotor diameter, the GE 1.5sl/sle turbine has a value for tonality of **(ΔL_a) ≤ 4 dB**, irrespective of wind speed, turbine type, hub height, and grid frequency.[3]

1 Simplified from IEC 61400-11: 2002 equation 7

2 Here referring to the unofficial release of the IEC 61400-14 TS ed. 1, labeled as 'CDV' (committee draft for voting)

3 R_0 and ΔL_a are defined here according to IEC 61400-11: 2002

5 Third Octave Band and Octave Band Spectra

Following is a table with the octave and third octave band values with a sum of 104 dB.

Note: these values are informative only.

A-weighted octave band and third octave band sound power level spectra												
Frequency [Hz]	50	**63**	80	100	**125**	160	200	**250**	315	400	**500**	630
L_{WA} [dB] 1/3 octave	76.2	79.9	82.6	84.8	86.7	92.4	90.7	92	94	94.3	93.8	93.2
L_{WA} [dB] octave	85.1			94.0			97.2			98.6		
Frequency [Hz]	800	**1000**	1250	1600	**2000**	2500	3150	**4000**	5000	6300	**8000**	10000
L_{WA} [dB] 1/3 octave	94	92.8	92.3	91.5	89.6	87.1	84.8	82.2	78.6	75.9	71.3	70.8
L_{WA} [dB] octave	97.9			94.5			87.3			78.1		

Table 5-1: Third octave band and octave band spectra